Peer review of papers and technical reports on the impact of HCl emissions on eco-systems and review on the impact of HCl emissions that have previously been underestimated

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This note reviews publications and technical reports on the impact of HCl emissions on ecosystems. This includes consideration of the impact of HCl emissions that have been previously unreported.

HCl is a highly corrosive gas that will damage metal structures and buildings made of limestone. If high levels of HCl dissolve in a water body, it can result in harm or even the death of aquatic organisms. The very high solubility of HCl means that releases to air are rapidly dissolved in moisture in the air and are quickly washed out by rain. Potentially soils and water bodies, such as lakes, may be sensitive to this acid rain, if amounts of it falling are above certain amounts defined as "critical loads". This makes HCl pollution a local environmental problem and a global concern.

The following report: “Development of a Methodology to Summarise and Track Air Pollution Effects on Ecosystems at Regional Scales” January 2010 SNIFFER, Scottish Environment Protection Agency, Northern Ireland Environment Agency, Environment Agency Project ERO7 stated that acid deposition is defined as atmospheric input to ecosystems that may acidify soils and freshwaters. This includes species derived from SO_2, NOx and NH_3 emissions. It also refers to HCl but describes it as a minor pollutant in terms of acid deposition.

A literature review (see Appendix) has shown that there has been very limited research into the effects of HCl on ecosystems. It is assumed that this is because the effect of HCl has been discounted as a possible source of acidification in ecosystems that are distant from their emissions source. It is generally thought that HCl will not travel far from where it is emitted. This is thought to be because HCl molecules are highly reactive, so dissolve in moisture in the air and fall out with precipitation in the immediate vicinity of an emissions source.

The above assumption possibly explains why research into the impact of HCl has not been extensive. The lack of research also means that the effects of HCl on the environment have not been investigated and so could potentially have been underestimated.

From the literature review only one research paper on this subject was identified (*Hydrochloric acid: An Overlooked driver of Environmental change. Chris D. Evans , Don T. Monteith, David Fowler, J. Neil Cape and Susan Brayshaw; Environmental Science and Technology. 2011, 45, 1887–1894*). It stated that research on the ecosystem impacts of acidifying pollutants, and measures to control them, has focused almost exclusively on S and N compounds. HCl, although emitted by industrial processes, such as coal fired power stations and waste incineration plants, has been overlooked as a driver of ecosystem change because most of it was considered to redeposit close to emission sources. The paper argues that this has led to the assumption that HCl is a localised pollutant, which does not affect locations far from emission sources.

The paper states that HCl is highly mobile in reducing environments, which means it is a more potent acidifier of wetlands than S and N. It states that historically, it is possible in the UK that HCl has been the major driver of peat land acidification.

Data is presented on pH and levels of sulphate and chloride ions from a monitoring network that collected rainwater samples from 26 sites and water samples from 22 lakes and streams between 1986 and 2007. The results showed elevated concentrations of HCl, even at sites far from coal-burning power plants.

The paper concluded that HCl accounted for 30 to 40% of the acidifying ions in the rainfall samples. Instead of falling out with rain close to the source, the HCl may have reached ecosystems at a considerable distance from the emissions source by traveling in non-precipitating clouds.

The above shows that limiting emissions of HCl from industrial processes is critical because it is acutely toxic and can potentially impact on a wider area than previously thought. The development of accurate and reliable measurements of industrial emissions is an important part of the aim to limit emissions of HCl.

Appendix: information on literature review

The Environment Agency Literature review team carried out a literature review using the approach described below.

Primary Question

Impact of hydrogen chloride emissions and hydrochloric acid on ecosystems, in order to review the impact of hydrogen chloride emissions that have previously been underestimated.

Background

The purpose of this literature review was to support the HEROES project on improving hydrogen chloride measurement techniques from large industrial processes, such as waste incinerator**s** and combustion plants. This will help ensure that industry can demonstrate that they meet the more stringent emission limit values in BREFS.

The scope of this literature search covers any geographical area within the last 10 years.

Results

A knowledge map has been provided on an Excel spreadsheet called Impacts of HCl provides. This provides information on peer reviewed and grey literature.

Search Strategy

The following key words were used for the literature review:

HCl, hydrogen chloride, hydrochloric acid, chlorine, atmospheric HCl

Impact, environmental impact, environmental change

Impact on: Environment, ecosystem, ecosystems, acid rain, acidification, air pollution, air pollutants, soils, freshwaters, surface waters

Emissions from: emission sources, industrial, industrial activities, incinerator, MSWI, power station, combustion plant, coal burning, coal-burning, coal combustion, power generation, stack gas emissions

Search Sources

The following sources were searched:

- www.scopus.com
- http://web.b.ebscohost.com
- https://www.sciencedirect.com/topics/engineering/hydrochloric-acid
- https://nepis.epa.gov/
- https://www.epa.gov/electronic-reporting-air-emissions/cedri
- http://ethos.bl.uk/
- https://www.ceh.ac.uk
- https://duckduckgo.com

Bibliography

EVANS, C.D., MONTEITH, D.T., FOWLER, D., CAPE, J.N. and BRAYSHAW, S., 2011. Hydrochloric acid: An overlooked driver of environmental change. *Environmental Science and Technology*, vol. 45, no. 5 [viewed 22 January 2020], pp. 1887-1894. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-79952153991&doi=10.1021%2fes103574u&partnerID=40&md5=7f59ff61794bc04bd38a248294f028c9 SCOPUS. ISSN 0013936X. DOI 10.1021/es103574u.

Notes

This literature review presents information available from scientific literature and internet sources. They do not represent Environment Agency positions or policies. Links to third party articles, documents and websites are provided for information only.

Abstracts or full articles may be available to purchase if required.